Proven DryCal TECHNOLOGY

DryCal 800
User Manual

NVLAP Lab Code 200661-0

MesaLabs

MesaLabs

Mesa Labs' Commitment

As a manufacturer of critical equipment, quality is the highest priority in our manufacturing process. Mesa Labs commits to providing creative, innovative thinking and the engineering and scientific expertise needed to produce gas flow-related products and solutions that are universally recognized for their superior performance, quality and value.

Proven DryCal technology is the recognized leader in gas flow measurement, providing the industry's most reliable products, service and solutions for professionals in environmental protection, workplace safety, industrial process control and laboratory calibration.

We strive to provide the closest NIST-traceable, legal defensibility of any flow calibration equipment manufacturer, and we actively maintain our NVLAP (NIST) ISO 17025 laboratory accreditation in order to support our claims and continually improve our quality system and laboratory proficiency. Thank you for purchasing our products. From all of us at Mesa Labs, best wishes for many years of accurate, defensible primary flow measurements.

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(973) 492-8400 FAX (303) 484-4992 www.mesalabs.com Symbol "MLAB" on the NASDAQ

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- Accuracy
- Reliability
- Convenience

Introduction

Congratulations! You've chosen the DryCal 800, featuring Proven DryCal® Technology from Mesa Labs. The DryCal 800 has five interchangeable cells that offer ±0.25% to ± 0.15% of reading standardized accuracy within a portable primary standard that's ideal for both volumetric and standardized flow applications where a high degree of measurement accuracy is required. Before you get started, we recommend taking a few moments to review this manual and familiarize yourself with the DryCal 800. If at any time you have questions regarding its operation, please contact Mesa through our web site (www.drycal.com), or call us at 973.492.8400 to speak with one of our knowledgeable customer support representatives.

Register Your Product

Before we begin, please register your product with Mesa Labs. To complete your registration, log on to our website at http://drycal.mesalabs.com/product-registration/ and complete the registration form. Registration of your new Proven DryCal product ensures your instruments warranty claim information is properly documented in Mesa's database, and provides you the peace of mind that your new calibration equipment is covered under our warranty service plan. Additionally, this registration will allow you to better manage your service and calibration dates through the receipt of timely reminders at 45 and 15 days prior to the recommended calibration date of your instrument.

Mesa recommends annual service and calibration of your Proven DryCal primary gas flow standard as a periodic quality assurance measure, as well as to provide you and your organization with a defensible audit trail of premier quality.

About Your DryCal 800

The DryCal 800 is a positive displacement primary piston prover for gas flow measurements in either pressure or vacuum applications. Using Proven DryCal Technology, it combines the accuracy of a primary standard with unequaled speed and convenience. Volumetric or standardized flow readings are obtained with the push of a button. The DryCal 800 can be set to take flow readings manually, one reading at a time, or automatically in the continuous auto-read mode. The DryCal 800 can be programmed for up to 100 readings in an averaging sequence.

Operation

The versatile DryCal 800 can be used to measure the gas flow rates at atmospheric pressure ± 7mmHg. Its Proven DryCal Technology features a near-frictionless piston and flow cell design that provides highly-accurate, liquid-free flow measurements of unequaled speed and convenience. For more information about our patented Proven DryCal Technology, please visit our website at drycal.mesalabs.com. The DryCal 800 consists of two primary components: The base and the flow cell. There are five interchangeable flow cell models, each with a designated flow range. The flow cell plugs into the base unit in order to create a complete, functional DryCal 800 system. The base component houses the main computer and timing circuitry. The flow cell is easily fitted into the base unit's interface connector and two guide pins.

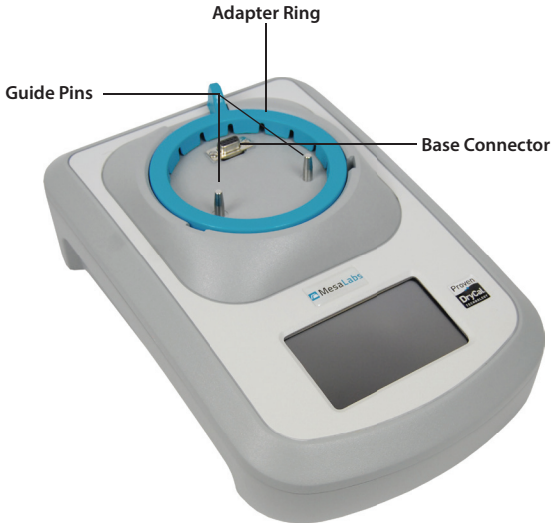
The flow cell performs the actual flow measurements. For this purpose, it houses a "piston and glass assembly" comprised of a borosilicate glass tube housing a precision-machined graphite piston. The flow cell also contains an integrated temperature sensor and barometric pressure transducer in the gas flow stream for instant conversion of the volumetric readings into standardized flow.

DryCal Pro software captures flow data from your DryCal instrument to a PC. You can also utilize Mesa's DryCal Pro software package available for download from http://drycal.mesalabs.com/drycal-pro-software/.

The DryCal Pro software allows you to:

- View and plot the flow data in real-time.
- Export your data to a Windows environment.
- Enter flow data from a flow meter and compare the flow measurements from your DryCal® precision calibrator.
- Upload the latest version of the firmware to your DryCal®.

Back



Front and Side

Unpacking Checklist

Your DryCal 800 has been packaged with care and includes all components necessary for complete operation. Please take a moment to check that you have received the following items. If you believe you have not received a full shipment or if you have any questions, please contact Mesa immediately.

Your DryCal 800 Base with the following:

- DryCal 800 Electronic Base
- Power Supply Adapter
- Leak Test Cable
- RS-232 Serial Cable
- USB Cable
- Certificate of Calibration

Your DryCal 800 Flow Cell Includes

- DryCal 800 Flow Cell
- Leak Test Plug
- Certificate of Calibration
- External Inlet Filter (800-3 only)

Warnings

⚠ The DryCal 800 is not rated intrinsically safe and is not for use with explosive gasses or for use in explosive environments.

⚠ The DryCal 800 is not designed for gas flows above the rated specifications of the flow cell in use. Please consult the product specification on page 12 of the manual for more information regarding acceptable gas flow ranges or visit our website at drycal.mesalabs.com for the most current product specifications.

⚠ For use with clean laboratory air or other inert gasses only.

Using Your DryCal 800

Getting Started

Ensure that the included 12V 3A AC power supply is connected to the base. Install the desired cell onto the base. All cells, except the -75 cell, should be installed with the blue adapter ring in place. If using the -75 cell, remove the adapter ring by rotating counter clockwise and lift off.

Turning the DryCal 800 On & Off

Flip the power switch in the rear of the DryCal 800 base to start the unit. An opening screen will appear followed by the splash screen.

The DryCal 800 is designed to operate using only AC power, this unit does not have a battery. Ensure that your unit is plugged in prior to turning on.

Communication Ports

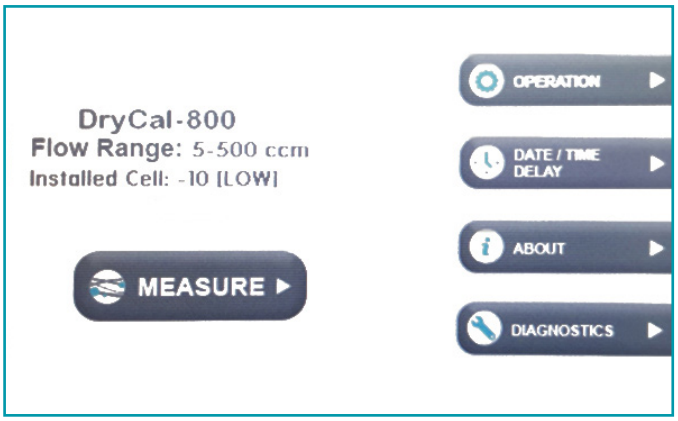
The DryCal 800 includes a USB-B port and RS-232 serial port for bidirectional communication, including data download and operation using the DryCal Pro software. The USB port includes a driver and does not require any additional driver download.

New firmware, as it becomes available, can be easily uploaded through the USB or RS-232 serial ports.

The side of the base contains a gold port that is used for pressure calibration at our facility. Nothing should be inserted into this port by the user.

On the back on the base is the clock signal port. This is used for verifying clock timing.

Using the DryCal 800 Touchscreen



The DryCal 800 uses a resistive touchscreen display for easy navigation through menu options and data entry. Numeric values can be changed using the blue arrows on the right of the screen. At any time, the user may return to the home screen by pushing the home icon in the lower left of the screen.

Home Screen

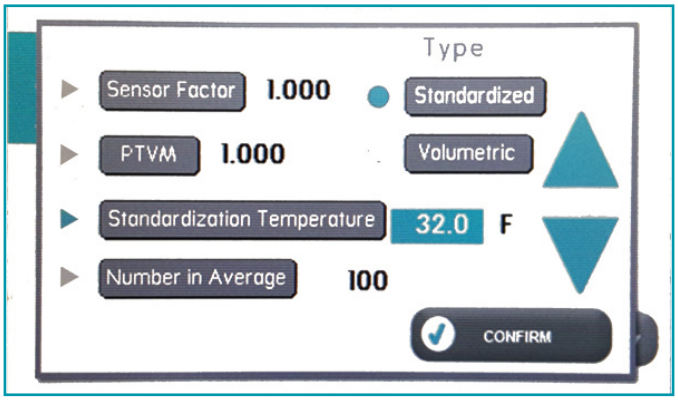
The Home screen allows access to the Measure screen and all submenus. You can return to this screen at any time during operation by pressing the Home button in the lower left corner of the screen.

Measure Screen

The Measure screen allows you to capture and observe instantaneous flow data. During operation, the measured flow rate, reading number, standardization information, and average readings are displayed at the top. Gas pressure and temperature inside the tube are displayed on a constant basis regardless of whether the unit is operating.

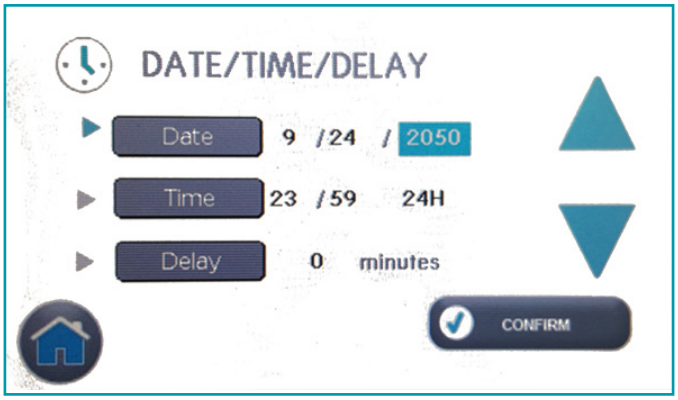
By pressing on the blue and grey portions of the screen allow you to access additional user-defined parameters. By pressing the blue flow measurement section, you can change the sensor factor, PTVM, flow standardization, standardization temperature, and reading average number. Pressing the grey gas temperature/pressure section allows you to change the pressure and temperature units. This option is only available through this menu.

Operations Screen



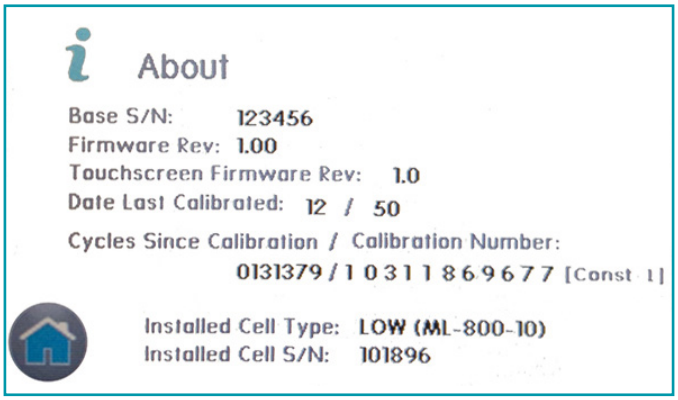
The Operation screen allows you to change measurement parameters including sensor factor, PTVM, standardized or volumetric flow, standardization temperature, and reading average number. When you are done changing these values, pressing CONFIRM will take you to the Measure screen. These input parameters can also be accessed by pressing the 'plus' symbol in the blue portion of the Measure screen.

Date/Time Delay Screen



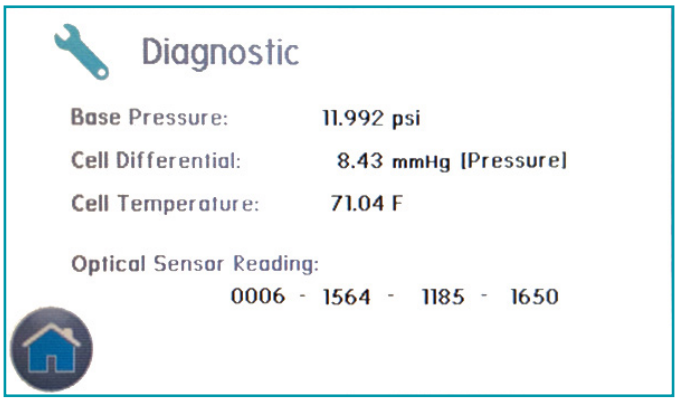
The Date/Time/Delay screen allows you to change the date, time, and delay between individual measurements. To edit these fields, press on the gray box of the field you would like to change. The value highlighted will change by using the arrows on the right.

About Screen



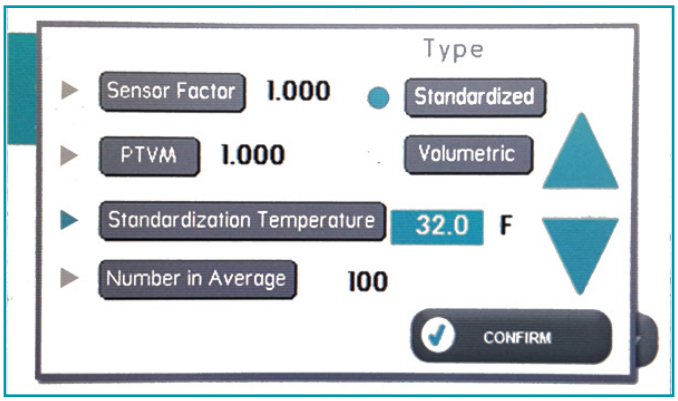
The About screen displays the base serial number, firmware revision, date of last cell calibration, cycles run since last calibration, calibration number, model of installed cell and cell serial number. Provide these numbers when contacting customer service or technical support.

Diagnostics Screen



The Diagnostics screen shows important information regarding the base and cell pressure, cell temperature, and optical sensor reading. These are continuously monitored when the base is operating.

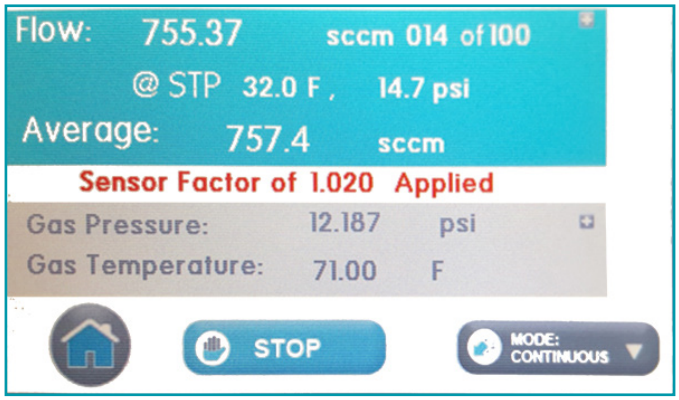
Setting User Preferences



The DryCal 800 offers enhanced electronics options to allow the user to define parameters specific to an application. These parameters may be entered from the Operation screen or by pressing the blue section of the Measure screen.

"Sensor Factor"

As applicable, change the sensor factor from its default value of 1.000 to the value provided by the MFC or MFM manufacturer. See Using Sensor Factors.



"PTVM"

PTV stands for Piston Tare Value, which is the amount of gas that passes around the piston during measurement. All DryCal calibration equipment has a factory set PTV that is stored in the memory of the DryCal cell. The value is typically very small: 0.008 for the ultra low flow cells, 0.1 ccm for low flow cells, 0.2 ccm for medium flow cells, and 1.4 ccm for the high flow cells. We adjust for this leakage by adding PTV to the measurements.

On our highest accuracy instruments, we allow for the adjustment of the Piston Tare Value with the Piston Tare Value Multiplier (PTVM). When using the instrument with gas species other than air or nitrogen, the molecular behaviors of these gases may degrade the PTV. For highest accuracy, the instrument's PTV can be adjusted. Adjusting the PTV is accomplished by entering a new PTVM. The PTV is multiplied by the PTVM to adjust the measurement. The default value for air and nitrogen is 1.000. The PTVM can be set to any value from 3.000 to 0.200.

For flows above 20 ccm, a new PTVM can be calculated by using the viscosity of the gas being measured and accurate results will be obtained. Calculate the PTVM by taking the ratio of the viscosity of nitrogen to the viscosity of the gas under test. For example, to calibrate hydrogen, consider the following: at 0°C, the viscosity of nitrogen is 165.31 microPoise, and the viscosity of hydrogen is 83.21 microPoise. Express these as 165.31/83.21, or 1.987, and enter 1.987 as the PTVM for this cell.

When measuring alternate gases at flows below 20 ccm, or for absolute best accuracy, it may be necessary to perform a dynamic leak test using the gas under test. Contact Mesa for information on this test.

"Standardized or Volumetric"

Choose whether you would like to conduct standardized or volumetric flow readings. The user can select the standardization temperature. The standardization pressure is set at 760mmHg (14.7 psi = 1 atm = 1013.25 mbar). Change the standardization temperature by selecting this option and changing the value using the arrows.

"Number in Average"

Changes the quantity in an average sequence (consecutive readings) from 1-100. Default value is set at 10.

Installing & Removing Flow Cells

The DryCal accepts interchangeable DryCal 800 specific flow cells for different flow ranges. When a cell is installed, the home screen displays the model number and flow range of the installed cell. If no cell is installed, this information will be blank. The base includes a blue friction fit adapter ring that should be removed when using the -75 cell due to its larger diameter. Replace this adapter ring when using the other cells.

Installing Flow Cells

1. Ensure blue adapter ring is installed for using all cells except the -75. Remove the ring if installing the -75 cell.
2. Position the selected flow cell into the base opening, its top label facing you.
3. Carefully align the cell with the guide pins; when the guide pins are engaged, press down.
4. When powered on, the DryCal 800 senses which cell is installed and displays the appropriate units for that cell.

Removing Flow Cells

Grasp the flow cell firmly, hold the base in place, and lift upwards.

Factory Default Settings

The DryCal 800 has a number of user-definable features and settings.

Parameters	Factory Settings	Optional Settings
No. of Readings in an Averaging Sequence	10	1-100
Atmospheric Pressure	mm Hg	mBar, kPa, PSI
Temperature	ºC	ºF
Standardized Temperature Setting	0 ºC	0.0-50.0 ºC

Connecting the DryCal 800 to a Gas Flow Source

The accuracy of the DryCal 800 is dependent upon its source being stable. An unstable flow source may produce inconsistent readings. Flow direction is indicated on the cell. To use a pressure flow source, connect to the inlet fitting, or to use a vacuum flow source, connect to the outlet fitting.

The DryCal 800 is designed to be used at ambient pressures only. This is easily accomplished by leaving the outlet of the flow cell open to atmosphere for pressure applications or the inlet open to atmosphere in vacuum scenarios. If tubing is needed to exhaust test gases to a fume hood insure that the exhaust tubing is of sufficient diameter such that the pressure to the DryCal 800 calibrator does not exceed 5 inches of water column (WC) above ambient pressure.

Taking Readings

The DryCal 800 default is preset for ten (10) readings in an averaging sequence. This parameter is user-definable from the Operation menu.

1. Press Measure on home screen.

- Press the Mode button to cycle through options for single, burst, or continuous readings.
- Press Start button to begin measurements.
- Press the Stop button to stop current flow reading and open valve.

Setting User Preferences

The DryCal 800 offers enhanced electronics options to allow the user to define parameters specific to an application. These parameters may be entered from the Operation screen or by pressing the blue section of the Measure screen.

Using Sensor Factors for MFC and MFM Calibration

MFCs and MFMs are originally calibrated by the manufacturer with a specific gas. When you use an MFC or MFM with a different gas than the one used in the last calibration, you must apply a flow correction factor to account for different gas properties that affect flow. The MFC or MFM manufacturer can provide the appropriate sensor factor value. The user can also apply this flow correction factor to the DryCal 800 readings.

To enable your DryCal 800 to scale its actual flow measurements to match the adjusted flow from the MFC or MFM, input the sensor factor into the DryCal 800 before calibrating the MFC or MFM.

The Sensor Factor is displayed on the run screen of the DryCal 800 as SF X.XXX. The default setting is 1.000. If you input a sensor factor other than 1, red text will display on the Measure screen showing the sensor factor applied.

Error Messages

"No Cell" - This message means that the cell is not present. Hit the home button to reset and install the cell.

"Piston Error" - This message means that the piston did not return to the bottom of the cell properly during operation. Hit the home button to reset.

If you continue to receive error messages after following these steps. Please contact customer service for assistance.

Annual Maintenance and Calibration

Your DryCal 800 is engineered to provide years of reliable service, with appropriate care and maintenance. Mesa recommends an annual calibration by our ISO 17025–accredited laboratory, to help ensure the best possible flow measurements and to provide an audit trail for those applications subject to regulatory requirements. If you should encounter any problems with your DryCal 800, immediately contact Customer Service and provide a detailed description of your situation, including DryCal 800 model and serial number, information about the flow source and the current calibration setup, environmental conditions during the test, the flow point or points that you're checking and an explanation of the issue you're experiencing.

Recertification

Your DryCal 800 primary piston prover is a precision measuring standard comprised of moving parts that are machined to extremely close tolerances. Additionally, various environmental factors, product wear, drift of the temperature sensors and pressure transducers, or inadvertent damage may adversely affect your measurement accuracy or general performance.

For these reasons, Mesa highly recommends having your DryCal 800 annually verified by our ISO 17025–accredited laboratory in order to ensure its measurement integrity. For those applications subject to regulatory or ISO requirements, verification by our accredited laboratory provides you with a defensible audit trail of the highest quality.

As the ultimate quality assurance measure, as well as to keep your DryCal 800 in top condition and updated with the latest hardware and firmware upgrades (as available), Mesa offers our elective Recertification program. Recertification is an intensive service and calibration package that provides pre- and post-dynamic flow comparisons against our Proven DryCal Technology lab standard; complete product refurbishment - including cleaning of the piston and glass assembly, installation of any available upgrades and other routine and preventative maintenance items; and full dimensional calibration, comprised of 20 or more tests using precision instruments and gauges, such as depth and laser micrometers and a temperature bath. When completed, you receive NIST-traceable, ISO 17025-, ANSI Z-540- and NIST Handbook 150-backed calibration certificates.

Recertification includes a 90-day service warranty should any related labor or parts replacements prove faulty.

Due to the intensive nature of our DryCal 800 Recertification, the time spent within our service facility during this process is generally fourteen days, beginning from the day we receive your product.

For a detailed explanation of our Recertification process, our laboratory and our accreditation, please visit our website at www.drycal.com and visit the Calibration & Repair page.

Sending Your DryCal 800 to Mesa

Please contact Mesa for a service quote before sending your DryCal 800 to our factory for elective Recertification or other service. You can get a service quote through our automated web-based system at http://drycal.mesalabs.com/request-an-rma/; by emailing csbutler@mesalabs.com; or, by calling us directly at 973.492.8400.

Sending your DryCal 800 to Mesa without a service quote may result in return of the instrument without inspection or a substantial delay in service turnaround time.

When requesting your service quote, provide your DryCal 800 model, serial number and revision level. Also, describe any product issues you may be experiencing. Please keep in mind that Mesa will not begin evaluation and service of your DryCal 800 until you have accepted and approved, in writing, our formal service quote. This protects both you and Mesa during this process and ensures a fair and efficient service experience.

If sending your DryCal 800 for repair or evaluation (rather than elective Recertification), please contact Mesa for technical support or troubleshooting assistance prior to shipping the unit. We will first attempt to resolve the situation over the phone or via email. If you've provided us with a detailed description of your DryCal 800 issue and application details and we're unable to resolve the situation by telephone or email, we'll issue you a service quote for the prompt return of your DryCal 800 for evaluation.

Please note that Mesa will make every attempt to verify your issue, as we want you to get the most out of your DryCal 800. However, if we are unable to detect a product issue or if we determine that the issue is application-related rather than product-related, we reserve the right to charge an evaluation fee.

Shipping

When shipping your DryCal 800, please ensure that the packaging is adequate to protect the instrument. Whenever possible, your DryCal 800 should be shipped in its original packaging or within a hard case, such as a Pelican carrying case (available for purchase from Mesa). We highly recommend using a standard freight carrier (e.g., FedEx, UPS) that supplies tracking numbers and insuring the product against damage in transit.

Mesa is not responsible for damage that occurs during shipment.

Storage

If you need to store your DryCal 800 for an extended period, please follow these guidelines:

Always store it in a clean, dry place.

DryCal 800 Specifications

Interchangeable Flow Cell Models:

Model Number	800-3	800-10	800-24	800-44	800-75
Flow Range	0.5—50 mL/min	5—500 mL/min	50—5,000 mL/min	500—50,000 mL/min	1-100 L/min
Accuracy, Standardized	±0.25% 0.5-50 sccm ± 0.002 sccm	±0.15%	±0.15%	±0.15%	±0.15%
Time Per Reading	1—60 seconds	3—135 seconds	3—90 seconds	1—35 seconds	1-50 seconds
Weight	80 oz/2300 grams	85 oz / 2413 g	86 oz / 2439 g	88 oz / 2507 g	160 oz / 4535 g
Inlet Fitting	1/8 in	1/4 in	1/4 in	1/4 in	1/2 in
Outlet Fitting	1/8 in	1/4 in	1/4 in	1/2 in	1/2 in

Specifications based on averaged readings. Accuracy is stated as a percent of reading (including standardization, if applicable).

Basics:

Dimensions: Cell Model 3: 9.0 x 4.0 in / 229 x 102 mm
Dimensions: Cell Models 10, 24, 44: 13.3 x 4.0 in / 337 x 102 mm
Dimensions: Cell Model 75: 14.8 x 5 in / 375 x 102 mm
Dimensions: Base: (H x W x D) 3.9 x 8.5 x 12.6 in / 99 x 216 x 320 mm

Weight: Base 5 lbs / 2268 g
Gas Compatibility: Non-corrosive, non-condensing, non-combustible gasses. Less than 70% humidity.

Usage:

Flow Mode: Suction and Pressure
Configuration: Base with modular, interchangeable flow cells (five)
Temperature & Pressure Sensors: Yes, in the flow stream of each interchangeable flow cell
Reading Modes: Single, Auto or User-Specified Burst
AC Adapter/Plug: 12V DC, > 3.0A, 2.5 mm, center positive, North American standard, others available
Inlet and Outlet Fittings: Swagelok™
Operating Temperature: 15–30° C
Storage Temperature: 0–70° C
Operating Humidity: 0–70%, non-condensing
Display: Resistive touchscreen
Operating Pressure (Absolute): 15 PSI
Data Port: RS-232 Serial and USB-B
Warranty: 1 year; battery 6 months

Mesa highly recommends annual Recertification (product maintenance, pre and post dynamic flow comparisons and full dimensional calibration). This is elective and is not included as a warranty item.

All specifications are subject to change. Please contact Mesa or visit our web site at http://drycal.mesalabs.com for the most current product information.

DryCal Pro Software:

Visit Mesa's website to download your copy of DryCal Pro software (http://drycal.mesalabs.com/drycal-pro-software/). DryCal Pro captures flow data from your DryCal 800 directly to a pre-configured table. The data can be exported to selectable Windows office environment.

To run DryCal Pro, you must have Windows® XP or 7, Microsoft Excel® 2003 and up, and either a USB port or a RS-232 serial port.

Limited Warranty

Mesa Labs warrants equipment of its manufacture and bearing its nameplate to be free from defects in workmanship and material. We make no warranty, express or implied, except as set forth herein. Mesa's liability under this warranty extends for a period of one (1) year from the date of product's shipment. Mesa Labs warrants service performed on equipment at our factory for a period of ninety (90) days. During these periods, the warranty is expressly limited to repairing or replacing any device or part returned to the factory and proven defective upon evaluation. These warranty periods will not be extended under any circumstances.

Mesa assumes no liability for consequential damages of any kind. The purchaser, by acceptance of this equipment, shall assume all liability for consequences of its misuse by the purchaser, its employees, or others. This warranty is void if the equipment is not handled, transported, installed, or operated in accordance with our instructions. This warranty is void if any evidence exists that equipment has been opened, including breaking the DryCal warranty seal. If equipment damage occurs during transportation to the purchaser, Mesa must be notified immediately upon arrival of the equipment.

A defective part in the meaning of this warranty shall not, when such part is capable of being repaired or replaced, constitute a reason for considering the complete equipment defective. Warranty repair is separate from our elective recertification service, which includes calibration and associate calibration certificate. Mesa Labs will not provide recertification and related calibration certificate for equipment under warranty unless warranty repair affects calibration or calibration is requested and paid for by the purchaser.

Acknowledgment and approval must be received from Mesa prior to returning parts or equipment for credit. To obtain a service quote, contact csbutler@mesalabs.com with details of the warranty or service claim. Purchaser is responsible for return shipment of equipment to the factory for warranty and non-warranty repairs. Mesa Labs will provide ground shipment to the purchaser for warranty repairs. All shipments from Mesa Labs will be handled by FedEx, unless otherwise requested. If the purchaser elects to use a third party freight forwarder or another shipping carrier, the purchaser is thereby responsible for the shipment.

Mesa Labs periodically makes engineering changes and improvements on instruments of its manufacture. We are under no obligation to retrofit these improvements and/or changes into instruments which have already been purchased.

For refund of new products, equipment must be in a new and unused condition. A restocking fee of 30% of the product's value will be charged for returns after thirty (30) days. Mesa Labs will not accept any returns after ninety (90) days.

No representative of ours has the authority to change or modify this warranty in any respect.

MesaLabs

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